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(72) Inventors JOHN PAUL MORGAN and FRANK EDWARD MURRAY

(19)

(54) PROCESS FOR THE CONTROL OF AIR AND WATER POLLUTION FOR KRAFT PULP MILL

(71) We, CHEMECH ENGINEERING LTD., a corporation of the Province of British Columbia, Canada, of 1827, West 5th Avenue, Vancouver, British Columbia, Canada,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the control of air and water pollution in the operation of a kraft pulp mill.

In the normal operation of a kraft pulp mill, several by-products are formed which contribute seriously to the pollution of atmospheric air and water streams when released therein in unaltered form. The almost totality of such polluting by-products are malodorous organic sulphur compounds formed during the digestion step of the pulping process by reaction between the inorganic sulfide in the cooking solution and the lignin in the wood. These odorous compounds are carried from the digester in the black liquor or exhausted from the digester during the cooking period. In further steps of the process, said odorous compounds whether carried by the black liquor or vented from the digester are combined and subjected to condensation by methods well known in the art whereby they are separated into a liquid condensed portion hereinafter called "condensate" and into a portion which remains gaseous and is hereinafter called "non-condensables".

It is the principal object of this invention to provide a process whereby the odorous organic sulphur compounds present in both said condensate and non-condensables are oxidised to compounds which are non-pollutants or are easily transformable into further compounds which are non-pollutants for atmospheric air or water streams.

According to the present invention a process for the oxidation of odorous organic sulphur compounds present in the "condensate" and the "non-condensables" comprises passing a stream of a gas containing molecular oxygen, usually air, through the condensate to strip the odorous sulphur containing compounds therefrom, mixing the contaminated gas so obtained with the non-condensables and using the molecular oxygen present in the mixture as combustion oxygen in the oxidation at elevated temperature (with or without catalyst) of the odorous sulphur compounds stripped from the condensate and present in the non-condensables, said mixture having a concentration in total combustibles less than at which it becomes explosive.

In practice, air is continuously fed at a predetermined volumetric rate to a gas-liquid contactor and flows in countercurrent to a stream of the condensate which had been obtained in blow heat recovery and multiple effect evaporation operations. These operations are well known in the kraft pulp art and thus need not be described in detail here. The odorous organic sulfur compounds entering the gas-liquid contactor as components of the condensate are transferred to and leave the contactor in the exiting air stream. To the latter which is contaminated since it now contains the odorous compounds from the condensate, are added the noncondensables, i.e. the gases which were not condensed under the normal conditions used in the kraft pulp process for condensing the gases vented from the digester. The volumetric rate at which air is flown to the contactor is so chosen that the combined streams namely the stream of contaminated air and that of non-condensables, now ready to enter the thermal oxidation reactor contain concentrations of combustible materials which are substantially and safely below the lower explosive limits for the resulting reaction mixture. Preferably said concentrations should be less than one quarter of the lower explosive limits for the mixture. The odorous organic sulphur compounds are thereafter oxidized in the reactor at elevated temperature and converted into a mixture of sulfur dioxide, carbon dioxide and water vapour. Advantageously the oxidation is carried out in the presence of a catalyst such as

steel pieces e.g. steel pellets, rods or tubes.

The lower concentrations of combustible materials at which the above reaction mixture become explosive is where said mixture contains at least 2.8% by volume of said combustible materials. The volumetric rate at which air is flown to the oxidation reaction must thus be such as to provide a reaction mixture wherein the combustible materials constitute substantially and safely less than 2.8% by volume of the total mixture. For purposes of safety, it has been found that the concentration of combustible materials in the reaction mixture should not be allowed to exceed 0.7% by volume.

By elevated temperature, it is meant a temperature at which the malodorous sulfur compounds are substantially completely oxidized to sulfur dioxide. Where no catalyst is used, it has been found that the temperature should be at least 1400°F. Where steel is used as catalyst, a lower temperature can be used which nevertheless should be at least 800°F.

The temperature in the reactor may be generated and maintained by burning therein any suitable fuel material such as natural gas or fuel oil.

The following example based on an experiment carried out in a 500 ton per day kraft pulp mill illustrates the efficiency of the process of the invention.

EXAMPLE

Condensate Flow	250 USGPM*
Concentration of contaminants in the condensate:	
H_2S	3. lbs./ADTP**
Organic sulphides	4.5 lbs./ADTP
Other organics	7.5 lbs./ADTP
Non-condensable flow:	115 scfm (dry, 60°F.)
Concentration of contaminants in the non-condensable flow:	
H_2S	1.2 lbs./ADTP
Organic sulfides	4.5 lbs./ADTP
Other organics	3.4 lbs./ADTP
Stripping air flow:	4300 scfm***
Total air flow to the oxidation reactor:	6000 scfm
Average natural gas flow to the oxidation reactor:	90 scfm
Catalyst:	steel tubes
Temperature in the reactor	about 850°F.

Efficiency:

(a) Stripping

Removal of contaminants from the condensate:

H_2S	99%
Organic sulfides	97%
Other organics	75%

(b) Thermal oxidation

Conversion of sulfur contaminants to SO_2: 99%

*USGPM means United States Gallon Per Minute

**ADTP means Air Dried Ton of Pulp

***scfm means standard cubic foot per minute.

WHAT WE CLAIM IS:—

1. A process for the oxidation of the malodorous organic sulphur compounds present in both the condensate and the non-condensables formed in the operation of a kraft pulp mill comprising passing a stream of a gas containing molecular oxygen through the condensate to strip the malodorous organic sulphur compounds therefrom, mixing the contaminated gas so obtained with the non-condensables and using the molecular oxygen present in the mixture as combustion oxygen in the oxidation at elevated temperature, as hereinbefore defined, of the malodorous sulphur compounds present in the mixture, said mixture having a concentration in total combustible materials less than that at which it becomes explosive.

2. A process as claimed in claim 1 wherein the mixture contains less than 2.8% by volume of combustible materials.

3. A process as claimed in claim 1 or 2 wherein the concentration of combustible materials in the mixture does not exceed 0.7% by volume.

4. A process as claimed in claim 1, 2 or 3 wherein the elevated temperature is at least 1400°F.

5. A process as claimed in claim 1, 2 or 3 wherein the oxidation is made in the presence of a catalyst at a temperature of at least 800°F.

6. A process as claimed in claim 5 wherein the catalyst is steel.

7. A process as claimed in any preceding claim wherein the gas containing molecular oxygen is air.

8. A process as claimed in any preceding claim wherein the oxygenation temperature is generated and maintained by burning a suitable fuel material.

9. A process as claimed in claim 1 substantially as hereinbefore described with reference to the foregoing Example.

W. P. THOMPSON & CO.,
12, Church Street,
Liverpool, L1 3AB.
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